

THE TECHNIQUE OF OPERATIONS FOR THE RELIEF OF APPENDICITIS.

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IN DISCUSSING the technique of operations for the relief of appendicitis it will be desirable separately to consider those in which the operation is begun by the making of a free opening into the general peritoneal cavity and those in which it is limited to the evacuation of the contents of an abscess of considerable size without such exposure of the peritoneum. In the first group are included those operations that are done in a period of quiescence after recurrent attacks, those done in the early stage of a progressive attack, with or without abscess or general peritonitis, and those in the later stage when the abscess has formed in one of the rarer positions and is not adherent to the anterior wall of the abdomen; the second group is composed of those operations that are done in a late stage of the affection for the simple evacuation of an abscess that can be reached without exposure of the uninvolved peritoneum, either by an incision directly into it through the anterior abdominal wall or by a more indirect route along the floor of the iliac fossa, or through the rectum.

First Group.—As it is not always easy to recognize in advance the position or condition of the appendix, the presence or absence of pus, or the position and relations of the abscess if one is present, the operation cannot be ordered in all its details from the beginning, but the surgeon must be prepared to follow at any moment the operative indications that arise as he advances. This fact creates some embarrassment in the

preparation of a formal description. The plan here adopted is to describe, first, the general method with the details employed in the simple forms, and then to give the variations in procedure which may be made necessary by varying conditions. I shall therefore first describe the steps taken in the removal of an appendix in the early stage of its inflammation or in a period of quiescence after recurrent attacks, and then indicate the steps made necessary by the presence of pus in small or large amount, or by the exceptional position of the abscess or composition of its wall.

In addition to the instruments and appliances habitually prepared for use in all major operations, the surgeon needs an aneurism needle charged with stout catgut, two retractors, the blades of which, bent at a right angle to the handle, are about 3 inches long and $1\frac{1}{2}$ inches wide, several large flat sponges, and a dozen napkins not too thick. The sponge and napkins, after efficient disinfection or sterilization, should be kept in hot water that has been thoroughly boiled. The number of the sponges, flat and small, should be noted. An abundance of hot and cold boiled water, warm antiseptic solutions, and towels must be provided.

If time has permitted, the abdomen of the patient should have been prepared by several hours' contact with a layer of green soap, followed, after washing, by a dressing of compresses thoroughly wet with a bichloride solution.

After anæsthetization, the patient is placed upon his back on a high narrow table, his lower limbs and chest wrapped in blankets, the abdomen left exposed. Rubbersheets are placed over the blankets and turned under at the edges adjoining the abdomen. The abdomen is then shaved, scrubbed with soap and water, washed off with water, then with alcohol or ether, and then with a 1-1000 bichloride solution. The rubbers are then widely covered with towels wrung out in the strong bichloride solution, and another towel is placed on each side so as to leave only the right half of the abdomen exposed.

In selecting the site of the incision the choice lies between the median line below the umbilicus, and the outer margin of the right rectus abdominis muscle at about the same level. The latter is the one habitually chosen for the early operation,

the former being reserved for cases of doubtful diagnosis or for special indications. The reasons for this preference for the lateral incision are very strong; it lies directly over the root of the appendix, it exposes the probable field of operation much more favorably than the other, and it creates a shorter and less exposed line of drainage. Certain advantages that have been urged in favor of the median incision appear to me to be inadequate to change the preference; they are: the greater probability of not encountering adhesions between the anterior wall and the intestines in the line of the incision, and the easier access to all parts of the peritoneal cavity for washing and drainage. The first mentioned advantage can be readily equaled at the other site by extending the incision upward if necessary; the second is rarely required, and such washing is, moreover, as will be subsequently explained, of doubtful value. If the existence of general peritonitis should indicate it, a second median incision can be subsequently made. The oblique incision (which will be described in the second group) is strongly recommended by Reclus, following Roux, but in making this recommendation he appears to have had in mind only cases of well-developed abscess, and mainly those adherent to the anterior wall. It is to be remembered that operation in the early stage or for recurrence, if not of exclusively American origin, has at least been developed and established by American experience, and that such development is still so recent that we have not yet had time to receive from abroad the results of much experience in, or study of, the subject by others.

Beginning at a point corresponding to the outer edge of the right rectus abdominis at or a little above the level of the umbilicus, the surgeon, standing at the right side of the patient, makes an incision through the skin and subcutaneous tissue directly downward for four or five inches, and then divides the aponeurosis of the external oblique for nearly the same distance. After having arrested the bleeding, he seeks the lateral edge of the rectus and divides the fascia beneath it. The peritoneum is next picked up with forceps in the upper part of the incision and opened, and the opening enlarged downward with the scissors or knife guarded by two fingers of

the left hand, care being taken to avoid the deep epigastric artery and vein which can be readily felt a little to the inner side of the lower part of the incision by the finger in the cavity. The layer of tissue overlying the peritoneum may be œdematous, but this is not a proof either of the presence of pus or of adhesions between the viscera and the abdominal wall. The upper portion of the incision is chosen for the opening of the peritoneum because it is there less likely to be adherent to the underlying omentum or intestines; if, however, it should appear to be adherent to them, that is, if it should be thickened and if it cannot be pinched up and clearly separated from them, the incision should be extended upward until a point is reached where the opening can be safely made.

The small intestines are then pressed upward and toward the median line, and held back with the flat sponges and folded napkins supported by the large retractors or the fingers of the assistant. If the appendix is not now visible, the operator raises the cæcum and seeks it behind the latter. If it is found to be free and with only its normal attachments, he raises it, passes the aneurism needle armed with a double catgut ligature through its mesentery close to its base, cuts the ligature in two, ties one piece about the mesentery, the other about the appendix, and divides the mesentery with scissors from its free edge back to the opening through which the ligatures were passed. He then presses two small sponges on handles close down about the root of the appendix to receive whatever may escape from it when it is divided, and cuts it away with scissors close to the ligature. The sponges being still held steadily in place, he sears the mucosa of the stump of the appendix with pure carbolic acid applied by means of a small pledget of cotton wrapped about the end of a probe, or with the Paquelin cautery.

This method of treating the stump has been employed in a large number of cases, and with uniformly satisfactory results, and it is, I think, to be unhesitatingly preferred to another that has been occasionally employed, that of not using a ligature, but turning in the cut end and suturing its opposing serous surfaces. The latter, even when it can be employed, certainly requires more time and is more difficult of execution,

and probably less safe; but, what is still more important, in most cases it is made practically impossible by inflammatory changes in the peritoneum and the sub-peritoneal tissue which are so swollen and infiltrated that it seems hardly possible that the procedure could be seriously contemplated by anyone who had occasion to deal with the appendix in such a condition. Furthermore, there is always the possibility that the small stump of the appendix thus left may include the original stricture or total obliteration of its lumen which gave rise to the process, and the operation leaves the patient as liable to a recurrence as if nothing had been done. The conjoint use of both methods, that is, the turning-in of the divided end and the placing of a ligature between it and the cæcum, as has been proposed, seems to me to combine with unfortunate thoroughness such disadvantages as may pertain to each, and to add thereto a dangerous one of its own, namely, the formation of a closed pouch with a suppurating and infected surface, which may be trusted, with considerable confidence, to produce a dangerous abscess ready to rupture and spread after the removal of the drainage tube and the closure of the external wound have made such a complication peculiarly perilous.

If the appendix is unrecognizable because of adhesions formed in previous attacks, it must be sought for by palpation of the thickened mass that may be felt behind the cæcum or along the mesentery of the terminal portion of the ileum. A valuable guide to the base of the appendix is to be found in the longitudinal bundle of unstriped muscle on the anterior aspect of the ascending colon which terminates inferiorly at the origin of the appendix. Embryology has taught us that the appendix is the original cæcum, the primary extension of the colon beyond the ileo-cæcal junction, and that the cæcum as we know it in the individual is a pouch subsequently formed on the outer aspect of the colon; consequently, the longitudinal bundles of the colon continue into the appendix, and the anterior one, which is in plain sight usually, leads directly to it.

The appendix having been found, it is freed from its adhesions by gently tearing them with a blunt instrument or by

cutting them when they are sufficiently thick and well-defined to make this desirable and free from the risk of accidentally wounding the intestine. It may sometimes be advisable to ligate these adhesions before dividing them, but I think this is rarely necessary. The apex of the appendix is sometimes firmly united to the floor of the iliac fossa by a cord that contains a small artery, and it is well to tie it before cutting it.

When the operation is done in the early stage of an attack a small quantity of pus may be found, either lying free in the fossa behind or on the outer side of the cæcum, or shut in by slight adhesions; in the latter case the traction made in lifting the cæcum or the appendix will usually cause the pus promptly to appear. It should be caught on a sponge as it flows, and the spot from which it came should be thoroughly wiped out and washed with a small amount of the strong bichloride solution before proceeding to the removal of the appendix.

If the operation is done at a somewhat later stage, and the appendix is unrecognizable because it is imbedded in and forms part of the wall of the abscess, it seems advisable, in the present state of our knowledge, not to attempt its removal, but to be content with the evacuation and drainage of the abscess.

The abscess may form behind the lower part of the ascending colon, apparently between the layers of the mesocolon, and may extend as far upward as the flank; in such case a small opening should be made into it at its lower end, after complete protection of the neighboring intestines with flat sponges and napkins, and the pus removed on sponges. In some cases it may be desirable to make a counter-opening for drainage in the flank just above the crest of the ilium, cutting from without inward upon the finger or a large blunt instrument as a guide.

If the abscess extends far down in the true pelvis a counter-opening may be made through the rectum, and the drainage tube brought out through the anus.

In the non-suppurative cases no cleaning of the peritoneal cavity is required, except the wiping out of such blood as may have escaped the protecting sponges. It is in my judgment

very much better that not only blood but also pus should be removed by sponges rather than by flushing the cavity with water; the latter plan may have its advantages under certain conditions, as, for example, when the pus is present in large amount and so widely distributed that its removal by sponging is impracticable; under such circumstances a stream of water carried by a long glass tube $\frac{1}{2}$ or $\frac{3}{4}$ inch in diameter to the furthest recesses of the peritoneal cavity will rapidly remove the greater part of the pus and leave in its place water thinly mixed with pus that can be more readily absorbed than the undiluted pus which it replaces. But as a method of cleansing, in any other sense, such flushing of the cavity is illusory; one has only to reflect on the impossibility of effectually cleaning with soap and water and a brush his infected hands to realize that such flushing of a cavity cannot fail to leave its wall still covered with the agents and products of infection.¹ Sponging is of course equally ineffectual, but it has the advantage of being more rapidly and easily done, and is free from the disadvantage which experiment has shown may be associated with such contact of water with the uninvolved peritoneum.

Experience has abundantly shown that entire removal of the pus and complete disinfection of the cavity occupied by it are not essential to recovery; on the contrary, the observation is constantly made that not only do patients with peritoneal abscesses habitually recover without unfavorable incidents, but also that even the parietal incision frequently heals without suppuration although its surface may have been bathed in the pus of the abscess. It is evident that absolute disinfection of the abscess-cavity is not essential, and that the protective measures commonly employed are sufficient to secure the patient against the occurrence of an infectious general peritonitis during the drainage of the abscess across a portion of the peritoneal cavity. This experience, in my judgment, disposes of the ingenious plan of a preliminary median incision suggested by Dr. Gerster, to enable us to ascertain whether an abscess may not be adherent to the anterior abdominal wall at

¹As a recent writer in the *Archiv f. klin. Chir.* has put it; "Spülerei ist Spielerei;" rinsing is ridiculous.

some point, and, if such adherence is found, to evacuate its contents without exposure of the general cavity. The abandonment of the removal of the appendix which that method, if closely adhered to, involves, appears to me fully to offset the reduction of the immediate risk.

Very exceptionally, the abscess may be found, not in contact with the floor of the iliac fossa, but imbedded among loops of intestines which wholly, or almost wholly, surround it and separate it from the abdominal parietes at all points. In such a case it lies nearer to, and perhaps crosses, the median line, extending into or hanging down in the true pelvis and is separated from the outer part of Poupart's ligament and the anterior superior spine of the ilium by a distinct interval that is easily recognized before the abdomen has been opened; the covering loops are also more or less extensively and firmly adherent to the anterior abdominal wall or omentum. Such a condition is more difficult to deal with than when the abscess is in the usual position, for the safest route to an outlet for the pus is not so clear, and the difficulty of drainage and chance of infection are greater. The identity of the component elements of the abscess-wall is unrecognizable amid the adhesions that bind them together and the false membranes that cover them, and the surgeon must blindly grope his way toward the abscess, feeling for points of softness or of least resistance, and gently tearing the adhesions with his fingers. In this search the finger seems to me to be better than any instrument because of the information and warnings constantly received through it. When the pus is reached it must be caught and removed as in the other cases.

It may happen in the suppurative cases that the appendix is indistinguishable amid the adhesions, and that it is inadvisable to seek for it with a view to its removal, lest in the search a loop of intestine should be torn or protective adhesions should be ruptured and a possibility of infection incurred which would not be compensated for by the removal of the appendix. It seems to me to be more judicious simply to empty the abscess and to trust to the obliteration of the appendix by the suppurative process.

If no pus has been found, and no infection has taken place

during the division and removal of the appendix, the abdominal incision may be entirely closed without drainage. The two methods of closing it which are widely used in abdominal section for other affections may also be employed here: either a single row of silk or silver sutures embracing the entire thickness of the abdominal wall, or separate union of the different layers with buried sutures of catgut; in the latter method a continuous suture is to be preferred for the peritoneum, and interrupted sutures for the other layers; or, after closure of the peritoneum, a single set of silver, silk, or silkworm sutures may be used for the remaining layers.

If pus has been found or if infection has taken place, drainage must be used, and with it plentiful packing of the abdominal cavity between the incision and the abscess with iodoform gauze. The value of this measure has been abundantly shown, both in appendicitis and in other affections complicated by the presence of pus, hæmorrhage, or infection. A rubber drainage tube is passed down to the stump of the appendix and surrounded with a loose packing of gauze; if the circumstances call for it (contact of pus with free loops of intestines; prolonged exposure and handling) other strips of gauze should be packed among the adjoining loops of intestines and between them and the abdominal wall adjoining the incision. The incision itself I prefer to close in part, certainly at its upper end, and sometimes also by a suture midway of the portion left open; others prefer to leave it entirely open and to close it with secondary sutures after removal of the tube and packing. My practice has been to withdraw the packing placed among the loops of intestine quite promptly—on the first or second day after the operation—and perhaps also to remove at the same time a portion of that packed about the tube. The remainder of the latter and the tube should also be removed as promptly as circumstances will warrant it; the delay need seldom be long, for limiting adhesions form quickly, and then the indication is to favor the rapid reduction of the size of the cavity. The iodoform acts favorably in several ways: it arrests the formation of ptomaines and pus; it drains well by capillary attraction; and it immobilizes the loops with which it is in contact. Its removal requires some force, and causes

some pain; it should therefore be done gently, but resolutely and steadily.

Secondary sutures may be advantageously used to approximate the granulating surfaces and thus hasten cicatrization and perhaps diminish the chance of the formation of a hernia.

Second Group.—Operations done in a late stage of the affection for the simple evacuation of the abscess without exposure of the uninvolved peritoneum. The removal of the appendix is not contemplated, although exceptional circumstances may make it practicable. The list includes simple division of the skin at a place where the abscess is pointing, and the opening in the loin of those exceptional abscesses which have spread to and lie mainly in that region, concerning both of which I shall say nothing more; the opening of the abscess through an oblique incision running more or less parallel to the outer part of Poupart's ligament past the anterior superior spine of the ilium, either directly or after passing for some distance backward outside the peritoneum along the iliac fossa, and finally, opening through the rectum.

Oblique Anterior Incision.—In the case of a large abscess of several days' duration, occupying the iliac fossa from Poupart's ligament upward, and adherent to the anterior abdominal wall without interposed intestines, the operation is very simple. An incision is made parallel to and about an inch above the outer half of Poupart's ligament and extending somewhat above and beyond the anterior superior spine of the ilium; it is carried through the skin, muscles, fascia and peritoneum, directly into the abscess; the pus is allowed to escape, a drainage tube and iodoform gauze are introduced, and the cavity is allowed gradually to close. The opportunity should be made use of to search for with the finger and remove any fæcal concretion or foreign body that may lie free in the cavity of the abscess or present in an opening in the wall of the appendix. If the appendix happens to be free from adhesions it may possibly be removed, but such an opportunity is entirely exceptional, and so long as the incision is restricted to the area shut off from the general cavity of the peritoneum by adhesions it will almost always be too small to permit an efficient search to be made for the appendix.

As the essential feature of this operation depends upon the direct continuity and union of the anterior wall of the abscess with that of the abdomen, the question of the existence of such union is capital, and unfortunately it must often remain unanswered until after the peritoneum has been actually divided. The temptation to seek evidence of the presence and proximity of the abscess by means of the aspirating needle after the peritoneum has been reached is great, and although the conditions may be more favorable for its safe use than when it must be plunged through the entire thickness of the abdominal wall, yet as it cannot tell of the presence of an unobliterated portion of the general peritoneal cavity in its path, and may even lead to a thrust of the knife and evacuation of the abscess through such a portion, it should be rarely resorted to. Incision is safer, for if it should open into the general cavity instead of into the abscess no harm is done, no great risk incurred, and advantage can be taken of the information thus gained to promote prompt adhesion between the walls of the abscess and abdomen and to complete the operation on the original lines after a day or two.

In like manner, if when the peritoneum is reached it is found to be freely movable upon the underlying abscess, their tardy union may be hastened by packing the wound with iodoform gauze, and the abscess may be subsequently opened with the knife or allowed to rupture spontaneously at the bottom of the incision.

The possibility, and, indeed, the probability in early cases, of not finding the abscess adherent in the line of the incision, led to a modification which I habitually employed until within the last two years, one which makes it possible with considerable certainty to reach and open even quite small abscesses without exposure of the general cavity. The modification consists in carrying the incision only through the transversalis fascia, and then proceeding a certain distance as for the extra-peritoneal ligature of the external iliac artery; that is, the finger is passed backward and inward between the peritoneum and the iliac fascia, gently lifting and pressing against the former, and guided by the sensation of intra-peritoneal resistance. The abscess is thus approached from behind at a point where

in the great majority of cases its wall is composed only of softened peritoneum, and under the pressure of the finger this softened wall gives way and the pus escapes. A drainage tube and a packing of iodoform gauze provide for its continuous flow, and the abscess closes in the usual manner. I have opened in this way abscesses containing not more than an ounce of pus, and as early as the third or fourth day, and while in many ways it falls short of the ideal method of early operation through the peritoneal cavity with removal of the appendix, I would strongly recommend its use in preference to indefinite delay when the circumstances of the surgeon or patient are such that the risks incurred in a resort to the other method of operation would be unduly increased, or when it is refused by the patient.

Evacuation Through the Rectum.—The technique of this method, which is rarely indicated, is simple. After the presence of the abscess in the true pelvis behind the bladder has been recognized by digital exploration, and perhaps verified by the aspirating needle, the patient is anæsthetized, the sphincter slightly stretched, and a knife, guided upon the left forefinger, is thrust through the anterior wall of the rectum into the abscess, making a longitudinal cut about half an inch long. A drainage tube with only one or two lateral openings near its upper end is passed well into the abscess, and its lower end left projecting through the anus. In the only case in which I have had occasion to resort to this method the tube escaped during defecation on the fourth day; it was not replaced, and the patient went on to complete recovery without indication of further need of drainage. Probably a longer retention of the tube would be needed in most cases.